SunPC 3.0 White Paper

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Preface

This paper will discuss how the SunPC products and PC emulation works and the performance of SunPC™ products compared to PCs.

The SunPC product is comprised of a software and hardware component—the SunPC software and the SunPC Accelerator. The SunPC software emulates a PC-AT. Most MS-DOS® applications that can run on a PC-AT, can run out of the box on SunPC products. The designers of the SunPC product line have made every effort to ensure robustness and PC-compatibility. The SunPC software offers fast 80286 to 80386SX performance in text-based DOS applications.

The SunPC Accelerator is a single-wide SBus card, containing an Intel® 486 processor and a custom Application Specific Integrated Circuit (ASIC). If a customer already has SunPC software, adding a SunPC Accelerator can increase the performance to close to 486 PC speed.

Technical Overview and Performance

Before examining SunPC performance, it's important to understand how PC emulation works. PC emulation is accomplished by taking PC hardware components essential for MS-DOS applications to work, and emulating them with software processes. One component, the Intel® CPU, is included with an accelerator, but other components still have to be emulated with software processes.

SunPC Emulation Software

While running the SunPC window, you can see the processes responsible for operation:

```
astro%: ps -ax | grep sunpc
 4315 co S     1:26 /usr/sunpc/bin/spc.sva_a3_bm_prod
 4316 co S     4:12 /usr/sunpc/bin/sunpc.dws.xview
```

Software Emulator

The process, `spc.sva_a3_bm_prod`, is the software emulator. It emulates an Intel 80286 processor in protected mode. It also emulates the supporting devices that a PC needs to operate, such as the floppy controller, video adapter, timers, and the serial and parallel port controllers. When the SunPC accelerator is used, the `spc_sva_a3_bm_prod` process off-loads some of the emulation, such as the CPU, timer, and graphic subsystem for video, but still handles all other components.

OpenWindows Environment Interface

The process, `sunpc.dws.xview`, is the interface between the SunPC software emulator and the OpenWindows environment. It includes support for properties forms, clipping, text rendering, and graphics when the accelerator is not installed. It also manages the copy and paste feature that allows text data to be transferred between SunOS® and DOS.

SunPC 3.0 Loadable Modules

The SunPC products use loadable modules for UNIX kernel support. A loadable module is object code that can be dynamically linked to the kernel anytime during system operation. The advantage of loadable modules is that the system doesn't have to be halted to load these modules and run the SunPC software. The SunPC loadable modules can be seen by using the `modstat` command:

```
astro%: modstat
Id Type Loadaddr       Size   B-major C-major Sysnum   Mod Name
 3 Pdrv ff031000      51000             59.              SunPC 3.0 loadable module R05
 2 Pdrv ff085000       2000             60.              winlock
```

The SunPC 3.0 loadable module provides kernel support for the SunPC Accelerator board. This includes handling I/O, interrupts, and memory management. In addition, extensions to the Sun serial driver are provided to convert signals for PC compatibility.

The `winlock` module supports the Direct Graphics Access (DGA) feature of OpenWindows® Version 3. Using DGA greatly increases the display speed of an application—in this case PC graphics. The display performance will decrease if the SunPC software is run on a generic X11R4 server.

SunPC Accelerator SX and DX

In designing the SunPC Accelerator, a lot of development went into determining what needed to be accelerated in hardware, and what could remain in software. The SunPC Accelerator is a single-slot SBus card (3" x 5") with a 486 processor, a 32-Kbyte direct-mapped, write-back cache, and a custom ASIC developed by Sun. The processor comes in two flavors—a 486 SX running at a speed of 16 MHz, or a 486 DX running at 25 MHz. The SX designation for the 486 is different than for the 386. The only difference, besides the speed, between a 486 SX and DX is that the DX has a built-in floating point co-processor, while the SX does not.

Other features of the hardware accelerator include the 32-Kbyte direct-mapped, write-back cache. A write-back cache is more efficient than a write-through cache, which most PCs have. Because of this advantage, the hardware accelerator can offer a higher performing cache at half the size.

Lastly, the custom ASIC accelerates the VGA emulation. The ASIC allows for Super VGA modes to be available, including an 800 by 600 MS-Windows® display driver provided with the SunPC software. The ASIC also mediates PC address spaces with SPARCstation™ address space and does so with high performance.

SunOS/DOS Integration

SunPC has a number of integration features that make it easier to work between the DOS and SunOS environments.

- Copy and Paste — text data can be copied and pasted between text-based DOS applications and SunOS. This works from SunOS to MS-Windows, but since Windows is a graphic display, you can't copy to SunOS.
- Network drives — allows DOS applications to access any UNIX file system, either locally to the system or on the network. For most DOS applications, using a network drive will give good performance. If more performance is desired, the C: drive can be used. The C: drive is a SunOS data file that appears as a disk partition to DOS.

- Serial and parallel ports — DOS applications requiring communications ports use the two serial ports on the SPARCstation. A properties form is available to enable xon/xoff if required. The SunPC software emulates 3 parallel ports to allow network printers to act as directly connected printers. Additional support for PostScript and Epson FX80 printing is provided.
- Keyboard and mouse emulation — The SunPC products uses X11 keysyms in establishing keyboard layout. This allows any Sun European keyboard to be used with SunPC products. The Sun mouse can be made to emulate a Microsoft bus mouse, which provides compatibility with MS-Windows™ and other applications.

Benchmarks

The benchmarks are meant for users to gauge the relative performance of the SunPC product as compared to PCs. The benchmarks measure both low-level functions and real application use. While care was taken to maintain consistency, your results may be different.

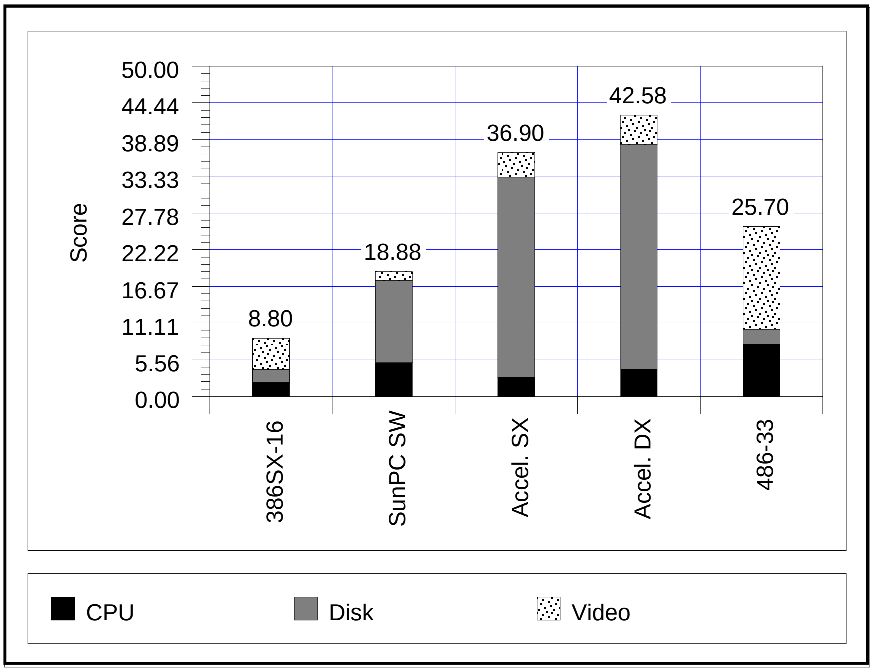
Benchmark Systems

The SunPC system used in the benchmarks was a SPARCstation IPX™. The SPARCstation IPX system was configured with 16 MBytes main memory, 32 MBytes of swap, and was equipped with a 207 MByte internal SCSI disk drive. The SunPC C: drive was loaded with all the benchmark and application software. The same system was used for all tests of the SunPC Software, Accelerator SX, and Accelerator DX.

The PCs used in the benchmark testing included a Toshiba 2000SX (CPU: Intel 80386SX-16 MHz) with 5 MBytes of memory, 40 MByte disk, and an external VGA monitor. The other PC was a 486-33 no-name clone with 8 MBytes of memory and a 200 MByte SCSI disk. On both of these systems, the benchmark and application software were loaded and run on the C: drive.

Low Level Benchmarks

The Byte Benchmarks (version 2.1) were chosen to test the low-level performance of the SunPC products—in this case the CPU, disk, and video sub-systems. The CPU tests include sorting, integer math, and string move benchmarks. The disk tests include disk seek time and file I/O throughput. The video tests measure text scrolling and graphics display speed.

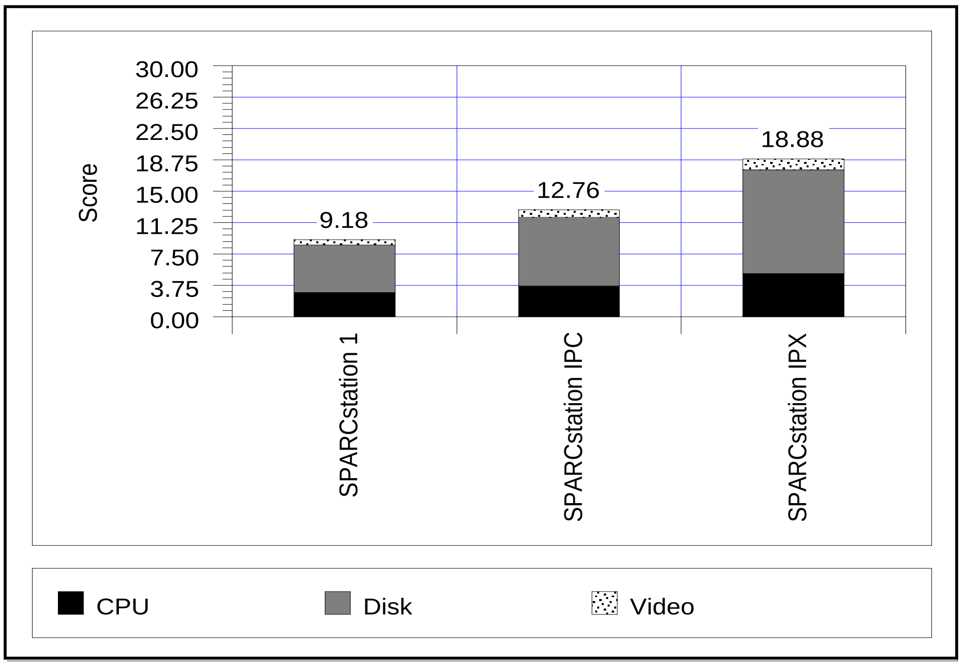


Low Level Test Comparison. Note: Higher number is better

The results of low level benchmarks should always be compared against application benchmarks. What is shown throughout the benchmarks is that the disk performance will be a recurring advantage of the SunPC products is always better than conventional PCs. This is due to the design of the emulator and how it takes advantage of the SPARC system's I/O bandwidth.

Performance Scaling with Processor

The SunPC Products take advantage of the SPARC processor performance. The faster processor will yield better PC performance. To show the scaling of the SunPC performance, the Byte benchmark was run on a variety of SPARCstation systems.

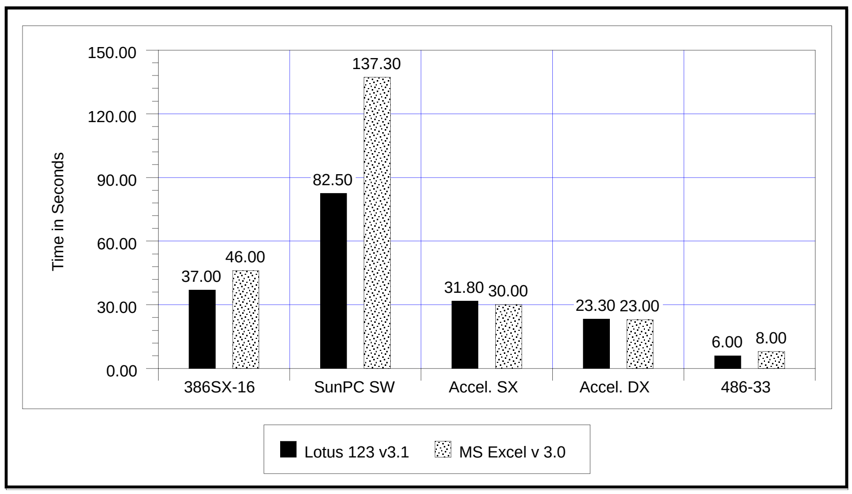


Low Level Test Comparison. Note: Higher number is bette

Spreadsheet Benchmarks

The spreadsheet benchmark is a marco-driven worksheet called bench13.wk1. The spreadsheet does a number of cell operations such as data fills, copying, moving, and deleting.

The two spreadsheets chosen to run the benchmark were Lotus® 1-2-3® version 3.1 and Microsoft Excel version 3.0. While a SunOS version of Lotus 1-2-3 does exist, it was interesting to see how an application that uses extended memory will perform. Excel was chosen to understand how a popular MS-Windows application would perform.



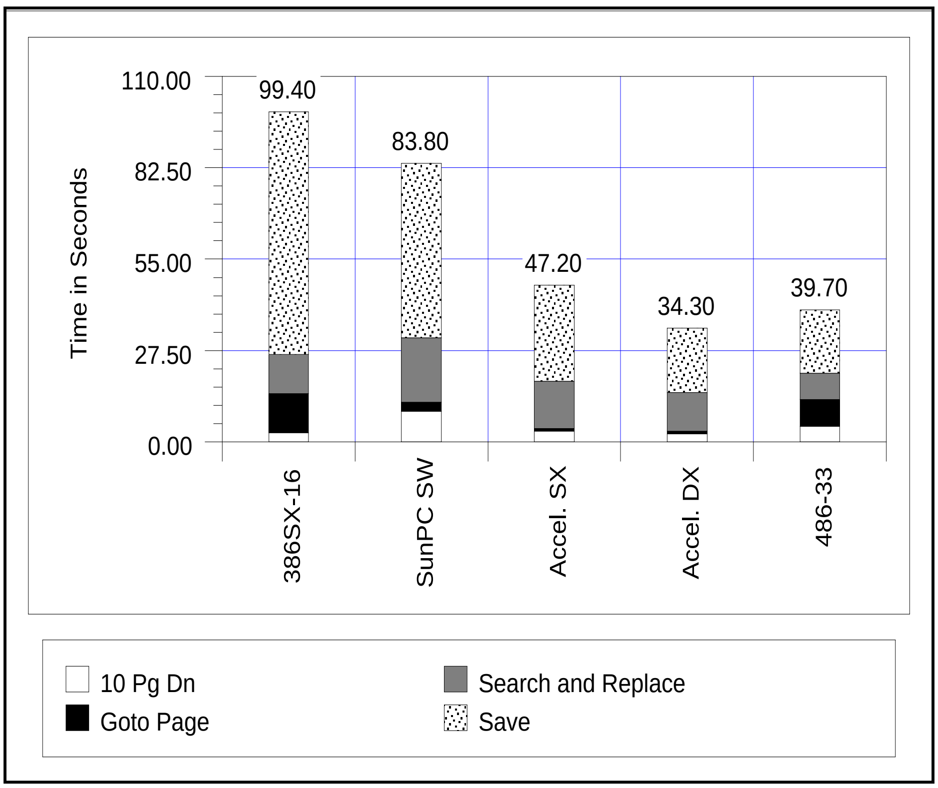
Spreadsheet Benchmarks. Note: Lower number is better

Spreadsheets are very CPU intensive. While the SunPC has very good overall performance, it can't approach a native PC's performance.

Word Processing Benchmarks

These benchmarks test how well the SunPC products would perform with an MS-Windows word processing application—Word for Windows™ 1.0. It's important to measure performance based on how a user would use the application. With that in mind, the benchmark tested the following functions:

- How fast you can move around a file — Two actions were measured. First was the time required to "page down" (hitting the Pg Dn key), 10 times. Second, how fast can one jump from one page to another.
- How fast changes can be made to the file — The word "bicycle" was searched for and replaced with "velocipede," 124 times.
- How fast a file can be saved.

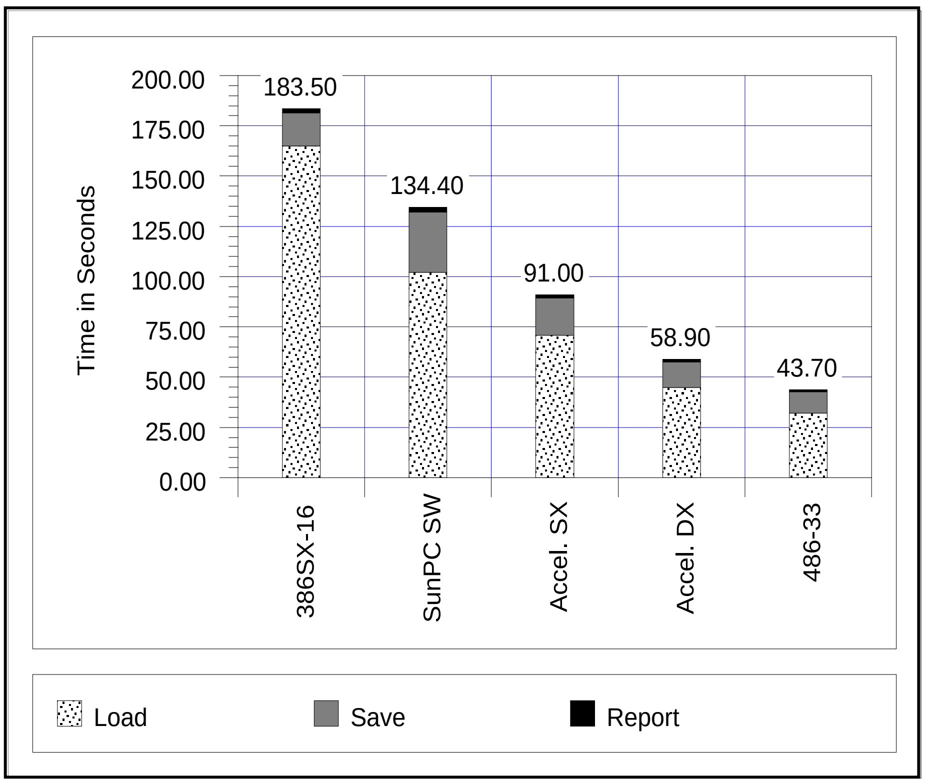


Word Processing Benchmarks. Note: Lower number is better

Again the disk performance shown in the Goto and Save tests shows how the SunPC emulation takes advantage of the SPARC system I/O speed.

Database

This test took a 500-KByte delimited ASCII database and used Borland® Paradox® version 1.3 to sort the database and generate a report. The database has over 6600 records. The test timed file loading, sorting on one field, and sending a report to the screen.



Database Benchmarks. Note: Lower number is better

Once more, the Disk I/O capabilities keep the SunPC products on par with their PC counterparts.

Performance Summary

SunPC 3.0 software, although emulating an 80286, gets 80386SX overall performance in DOS text-based applications. The SunPC Accelerator gets 386-25 MHz or better performance. In some cases, like disk performance, it outperforms a 486-33 MHz. This is because the SunPC products take advantage of a faster bus, and better disk throughput.

The SunPC software performs best with text-based MS-DOS applications. MS-Windows applications can be used with good performance with the SunPC Accelerator SX. For the best overall performance, the choice is clearly the SunPC Accelerator DX.

Application List

Applications known to work on SunPC 3.0:

Ability Plus

AMI Pro 1.0

Ashton-Tate dBase III+

Ashton-Tate dBase IV

Ashton Tate MultiMate II - 286 only

Autodesk AutoCad 10

Autodesk AutoCad 11 (DX only)

Borland Paradox 3.5

Borland Quattro Pro 2.0 & 3.0

Borland Superkey

Borland Turbo C++ 2.0

Brief

Carbon Copy Plus 5.0

Checkit

Computer Library

Crosstalk 3.61 & 3.8

DataEase

Epsilon 3.2

GEM Draw

GEM Paint

Harvard Graphics 2.3

HP Graphics Gallery

JetSetter

Lotus 123 2.2

Lotus 123 2.3

Lotus 123 3.1

Lotus Agenda 1.0 & 2.0

Lotus Allways

Lotus Works

MS-Codeview

MS-C 6.0

MS-DOS 5.0 upgrade

MS-Word 4.0 & 5.0

MKS Mortice Kern Toolkit

MS-Window 3.0:

- After Dark
- Aldus Pagemaker 4.0
- AMI Pro for Windows
- CrossTalk for Windows
- Excel for Windows
- Freelance for Windows
- Harvard Graphics for Windows
- Norton desktop for Windows
- 123 for Windows
- Tetris for Windows
- Win Slueth
- Word for Windows
- WordPerfect for Windows

MS-Windows 3.1

Microsofts's Programmer's Workbench

Microsoft Project

Mirror II

Norton Commander 2.0

Norton Utilities 5.0 & 6.0

OfficeWriter 6.1

PCTools 5.0 & 6.0

Procomm Plus 1.0 & 2.0

Prodigy

Q&A 4.0

Qedit

QEMM 5.1

QuickBasic

Quicken 3.0 & 4.0

Sidekick

SmartComm III

Spellbinder Desktop Publisher

Stackey

SuperCalc 5.0

Test Drive III

Timeline 5.0

TurboTax 92

Typografica

Wordstar 3.3 & 6.0

Ventura Publisher 2.0

Xtree Gold

386MAX

GAMES:

EYE OF THE BEHOLDER

FROG

HOPPER

JEOPARDY

LINKS

MONOPOLY

PANGO

PC-GOLF

PCINVAD

PCPOOL

QUBERT

TEST DRIVE III

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